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PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(72) Inventor WILLIAM PAUL WHITE

(54) IMPROVEMENTS RELATING TO CONVEYORS HAVING OPENWORK CONVEYOR BELTING

(71) We, UNITED KINGDOM ATOMIC ENERGY AUTHORITY, London, a British Authority, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to conveyors having conveyor belting of openwork type.

It has been established for some time that there is usefulness in many applications for a belt construction which can be caused to follow a path including curves in the plane of the belt. This capability must be additional to the more usual mode of flexure which is required for lapping over rolls and pulleys.

According to the invention a conveyor comprises an openwork conveyor belt having a series of transverse struts located in spaced relationship on a flexible but substantially inextensible elements, the struts projecting to either side of the element and being alternately interconnected at their ends to form a substantially zig-zag or serpentine configuration, and guide means cooperating with the interconnected ends of the struts to constrain the belt to curves in its path and in the absence of other support to maintain the attitude of the struts in the requisite plane.

The load carrying surface is constituted by the upper edges of the struts and spacing between them gives rise to the openwork character. Around a curve it is the strut ends on the inside of the curve which essentially must have a running engagement with the guide means by which the curve is defined. Such engagement may be indirect by virtue of the provision on the strut ends of anti-friction elements, such as rollers.

The strutting is conveniently strung on the flexible element with spacer pieces intervening between adjacent struts. With the element situated at the mid-depth of the struts a greater stability of the conveying surface is achieved, bearing in mind that the belt tension can only be present in the flexible element. A single element is best located centrally of the belt width. The use of more than one element is not excluded, especially if positioned near the centre.

The form of construction using alternate interconnections produces in effect a continuous strut array rather in the manner of a concertina. This concept lends itself to the use of a zig-zag folded strip to act as the strutting, the separation between the V or U legs of the strip being maintained by the spacer pieces. The strip may be of uniform width with plain edges; alternatively the edges may be lightly indented or otherwise fashioned for imparting pattern or grip to conveyed articles or for modifying the flexural characteristics of the strip. A metal strip, for example, can be readily selected to allow the elastic flexing action which assists in accommodating the forces generated as a result of drawing the inside edges over a curve-defining guide means. These edges, as constituted by the interconnected strut ends may be adapted in a variety of ways to reduce frictional effects. With a construction based on the folding of strip, the folds may be arranged to clamp in position an anti-friction attachment; alternatively the connecting pieces used in a composite construction of the concertina may themselves incorporate low friction rubbing pads.

A conveyor utilising belting as above described would additionally comprise a drive means for imparting movement to the belt along its path.

The guide means may take the form of a channel section having a channel width large

[*Price 25p*]

enough to receive the strut ends. Guide means in the form of a channel is suitable for guiding the conveyor belting around bends of large radius. In the case where the conveyor belting is required to negotiate horizontal bends of sharp radius a guide wheel may be provided on the inside radius of the bend the edge of the conveyor belting on the inside radius of the bend running in contact with the guide wheel. To reduce friction effects in guiding the conveyor belting around bends of larger radius where space availability precludes the use of a larger diameter guide wheel on the inside curvature of the bend a support belt may be provided running on rollers in contact with the edge of the conveyor belting on the inside radius of the bend.

Drive means for the conveyor belting may be arranged to make driving engagement with the belting in the region of the flexible element. In this region belting using struts of strip form would present strip edges for engagement with a sprocket wheel or projections on a drive belt. The conveyor belting may also be driven by frictional drive from guide wheels at the points of sharp bends in the belting. Alternatively where the belting is guided around bends of larger radius by a support belt running on rollers such a support belt may be power driven to drive the conveyor belting by frictional engagement therewith. Further the guide wheels at bends of sharp radius in the belting or a support belt at bends of larger radius may be formed with sprocket teeth engaging between the ends of the struts at the edge of the conveyor belting.

In the case of conveyor belting made from zig-zag folded strip to define the struts the use of bends of sharp radii interconnecting the ends of adjacent struts means that the conveyor belting can negotiate tight horizontal bends. In this case, however, the gaps between adjacent pairs of interconnected struts at the outer radius of the bend will be large so that small articles can fall through the gaps or become trapped. The gaps may be reduced by employing bends of larger radius interconnecting the ends of the struts or the gaps may be reduced by bending the struts to form projections extending transversely into the gaps the projections on any one strut being staggered with respect to the projections on the adjacent struts. Alternatively additional members may be fitted projecting tranversely from the struts into the gap in the manner of the projections described above.

A preferred form of conveyor belting comprises individual cross struts the ends of the cross struts being of rolled tubular form, one end of each cross strut being formed to a smaller diameter than the diameter of the other end, the corresponding ends of adjacent cross struts being interconnected by the smaller diameter rolled end of the one cross strut fitting inside the corresponding larger diameter rolled end of the other cross strut. The rolled ends of the cross struts may provide location for antifriction rolling elements or sliding bearing pads which run a guide channel alongside each edge of the belting. For instance the antifriction bearing pads may be in the form of domed headed rivets fitted inside the interconnected rolled ends of each adjacent pair of cross struts the domed heads of the rivets constituting the antifriction bearing pads for the conveyor belting.

In another form of conveyor belting free running rollers extending across the width of the belting are mounted from the cross struts of the conveyor belting.

In the form of conveyor belting in which the ends of the cross struts are of rolled tubular form for interconnection one with the other the rollers may be mounted on shafts extending between brackets fitted in the rolled ends of the cross struts along each edge of the conveyor belting. The brackets along one edge of the belting may be inclined in one direction with respect to the longitudinal axis of the belting whilst the brackets along the other edge of the belting are inclined in the opposite direction so that the shafts carrying the rollers extend tranversely across the width of the belting between corresponding brackets on either edge of the belting.

Embodiments of the invention will now be described, by way of example, with reference to the drawings accompanying the Provisional Specification filed with application No. 12541/71 in which:

Figure 1 is an isometric view of part of a conveyor,

Figure 2 is a cross section along the line II—II in Figure 1,

Figure 3 is a cross section along the line III—III in Figure 1,

Figures 4, 5 and 6 are details of the conveyor shown in Figure 1,

Figures 7, 8 and 9 are modifications of the arrangements of Figures 4, 5 and 6,

Figures 10, 11 and 12 are details in plan view of various forms of conveyor belting fabricated from folded strip,

Figures 13 and 14 are details in plan view of modified forms of conveyor belting,

Figures 15, 16, 17 and 18 are isometric details of constructional modifications of the type of conveyor belting shown in Figure 1,

Figures 19, 20, 21 and 22 are details in plan view of various forms of conveyor belting constructed from individual components,

Figure 23 is an isometric view of part of a second form of conveyor,

Figure 24 is a detail of a modified form of guide means for the conveyor belting,

Figure 25 is an isometric view of part of a third form of conveyor.

In the arrangement shown in Figure 1 of the drawings an openwork conveyor belting 1 is formed from a flat metal strip which is bent to form a substantially zig-zag or serpentine configuration. The belting 1 can be regarded as consisting as a series of cross struts 2 which are alternately interconnected at their ends by U-bends 3.

As shown in Figure 2 a flexible steel cable 4 passes through holes in the centre of each cross strut 2 and adjacent cross struts 2 are paced apart by tubular distance pieces 5 threaded on the cable 4.

The edges of the conveyor belting 1 run in slideways 6 which constrain the conveyor belting 1 to a required path. The U-bends 3 interconnecting the ends of the cross struts 2 of the conveyor belting 1 run between upper and lower side flanges 7 of the slideways 6 and as shown in Figure 3 the slideways 6 may be fitted with flat, wear resistant, plastic guide strips 8. As shown in Figure 1 the slideways 6 can define horizontal curves in the conveyor path particularly when the curves are of large radii. For tight curves, as shown in Figure 4, friction can be substantially reduced by fitting a wheel 9 which engages with the edge of the conveyor belting 1 on the inside radius of the curve. To reduce friction around horizontal curves of large radii, where space availability precludes the use of a large diameter idler wheel, the arrangement of Figure 5 can be employed, wherein a support belt 10 running on rollers 11 engages with the edge of the conveyor belting 1 on the inside radius of the curve.

A conveyor employing conveyor belting 1 may include several straight track sections and any required number of tight curves or curves of larger radii, which may be of left or right hand curvature. Preferably the conveyor belting 1 is in the form of a closed loop running at each end of its operative upper surface over a horizontal roller 12 as shown in Figure 6, and having a lower return section 13 between the rollers 12. As shown schematically in Figure 6 one or both of the rollers 12 may be mounted at its axis on a swing link 14 so that tension can be applied to the conveyor belting 1 by means exemplified by a spring 15 acting on the swing link 14 in Figure 6.

Propulsion of the conveyor belting 1 may be achieved in one or more of several ways. For example the wheel 9 in the arrangement of Figure 4, may be power driven to drive the conveyor belting 1 by frictional engagement therewith. Alternatively, as shown in Figure 7 the wheel 9 may have teeth 16 engaging between the U-bends 2 at the ends of the cross struts 2 of the conveyor belting 1. Similarly in the arrangement of Figure 5 the belt 10 may be in frictional engagement with the edge of the conveyor belting 1 and the belt 10 may be driven by driving of one or more of the rollers 11 which support the belt 10. Again, as shown in Figure 8 the belt 10 may have teeth 17 engaging between the U-bends 3 at the edge of the conveyor belting 1.

The roller 12 in the arrangement of Figure 6 may be power driven to drive the conveyor belting 1 by friction, or, as shown in Figure 9, the roller 12 may have teeth 18 which engage between the cross struts 2 of the conveyor belting 1.

Other ways for driving of the conveyor belting 1 include a toothed drive belt running on spaced rollers beneath a straight section of the conveyor belting 1 the teeth on the drive belt engaging from beneath between the cross struts 2 of the conveyor belting 1.

Referring to Figure 1 again it will be seen that the gaps between the ends of adjacent cross struts 2 of the conveyor belting 1 are much greater at the outside radius of a curve than at the inside radius of the curve. This is particularly so in the case of a conveyor belting in which the U-bends 3 at the ends of the cross struts 2 are of sharp radius, as shown in Figure 10, which is necessary if the conveyor belting is to be capable of negotiating very tight horizontal curves. In some cases fairly close spacing between the ends of the cross struts 2 at the outside of a curve may be desirable so that small goods cannot fall through the conveyor belting or become trapped. In such cases the gaps can be reduced by making the U-bends 3 at the ends of the cross struts 2 of large bend radius as shown in Figure 11. On an installation where the horizontal curves are all in the same direciton a compromise arrangement might be used as shown in Figure 12 wherein the U-bends 3 along one edge of the conveyor belting 1 are of large bend radius to minimise the gaps between the cross struts 2 when this edge of the belting 1 passes around the outside radius of a curve, whereas the U-bends 3 along the other edge of the conveyor belting 1 are of sharp bend radius to allow this edge of the belting 1 to negotiate tight horizontal curves in the track of the belting 1.

As shown in Figure 13 the openwork nature of the gaps between the cross struts 2 may be reduced by bending of the cross struts 2 to form lateral projections 19 thereon. The projections 19 on adjacent cross struts 2 are staggered so that they intermesh and do not interefere with the bending of the cross struts 2 relative to each other as the conveyor belting passes around a curve. In the arrangement of Figure 14 U-shaped members 20 attached to the cross struts 2 perform a similar function to the projections 19 on the cross struts 2 in the arrangement of Figure 13.

In the arrangement of Figure 1 the cable 4 passes through a hole in the centre of each cross strut 2 which necessitates the awkward business of threading the cable through the holes in the cross struts 2. However as shown

in Figure 15 slots 21 can be provided in the cross struts 2 instead of holes, so that the cable 4 can be simply dropped into position in the slots 21 and retained in position by a bridge piece 22 spot welded to each of the cross struts 2. Another method would be for the cable 4 to run below the conveyor belting 1, as shown in Figure 16, passing through holes in separate bifurcated brackets 23 which fit over and are spot welded to the cross struts 2.

Stability of the conveyor belting 1 in the horizontal plane is affected by the resistance of the cross struts 2 to transverse bending and within limits the thicker the cross struts 2 and the stiffer the conveyor belting 1, the better, so long as the conveyor belting 1 remains sufficiently flexible to negotiate horizontal curves. However when the conveyor belting 1 has to negotiate vertical curves, such as when passing around the horizontal roller 12 shown in Figure 6, each cross strut 2 has to flex in torsion. Consequently if the cross struts 2 are too thick or too deep the torsional stiffness will be too great for a vertical curve of reasonable radius to be negotiated. This difficulty can be avoided by corrugating or dishing the cross struts 2 longitudinally as shown in Figures 17 and 18 giving similar torsional flexibility to a thin cross strut but increasing the resistance to transverse bending.

Referring now to Figures 19, 20, 21, 22 these show a conveyor belting formed from individual cross struts 2.

In Figure 19 the ends of adjacent cross struts 2 are joined by U-shaped clips 24 which are spot welded to the ends of the cross struts 2.

In Figure 20 one end of each cross strut 2 is bent over and spot welded to the end of the adjacent cross strut 2.

In Figure 21 the ends of adjacent cross struts 2 are spot welded together in face to face contact, one end of each cross strut 2 having a U-shaped bend 25.

In Figure 22 the ends of the cross struts 2 are of rolled tubular form, one end 26 of each cross strut 2 being formed to a smaller diameter than the other end 27. The smaller diameter end 26 of each cross strut 2 fits inside the larger diameter end 27 of the adjacent cross strut 2.

Figure 23 shows a detail of a conveyor employing conveyor belting 1 of the form shown in Figure 22.

In the arrangement of Figure 23, as in the case of Figure 1, a flexible cable 4 passes through holes in each cross strut 2 and adjacent cross struts 2 are spaced apart by tubular distance pieces 5 threaded on the cable 4. As in the arrangement of Figure 22 the smaller diameter rolled end 26 of each cross strut 2 fits inside the larger diameter rolled end 27 of an adjacent cross strut 2. A ferrule 28 is fitted inside the smaller diameter rolled end 26 of the cross strut 2 of eac[illegible]erconnected pair of cross struts 2. Pins 2[illegible]ed into the ferrules 28 at each end hav[illegible]omed heads 30 which act as bearing pads providing edge support for the conveyor belting 1 by running in the slideways 6 which constrain the conveyor belting 1 to a required path. Such an arrangement of antifriction bearing pads is suitable particularly for small light duty conveyors. However for large heavy duty conveyors the arrangement of Figure 24 is more suitable. In the arrangement of Figure 24 a wheel 31 is mounted at the interconnected ends of each adjacent pair of cross struts 2 by a stub shaft 32, the wheels 31 running on parallel rails 33 which constrain the conveyor belting to the required path.

Figure 25 shows a detail of a conveyor of the type disclosed in Figure 22 but adapted by the provision of rollers 34 to operate as an accumulator conveyor. In the arrangement of Figure 23 support brackets 35 for the rollers 34 are fitted projecting upwards from the ferrules 28 at the interconnecting ends of the cross struts 2. Each roller 34 is mounted on a shaft 36 extending between corresponding brackets 35 on either edge of the conveyor belting 1. The brackets 35 along one edge of the conveyor belting 1 are all angled in one direction with respect to the longitudinal axis of the conveyor belting 1, whilst the brackets 35 along the outer edge of the conveyor belting are angled in the opposite direction. By this means the rollers 34 extend transversely across the conveyor belting 1. Bushes 37 fitted in the ends of the rollers 34 support the rollers 34 on the shaft 36. Dome headed pins 29 fitted in the ferrules 28 at the interconnecting end of the cross struts 2 on the underside of the conveyor belting 1 act as bearing pads running on the slideways 6 which in this case are of L cross section.

In operation of the type of conveyor shown in Figure 25 articles can accumulate against a stop at any point on the conveyor. The conveyor keeps running and at the point at which the articles accumulate the rollers 34 rotate beneath the articles as they pass under the articles. By this means sliding friction of the conveyor against the underside of the stationary articles is avoided.

WHAT WE CLAIM IS:—

1. A conveyor comprising an openwork conveyor belt having a series of transverse struts located in spaced relationship on a flexible but substantially inextensible element, the struts projecting to either side of the element and being alternately interconnected at their ends to form a substantially zig-zag or serpentine configuration, and guide means cooperating with the interconnected ends of the struts to constrain the belt to curves in its path and in the absence of other support to maintain the attitude of the struts in the requisite plane.

2. A conveyor according to claim 1 in which the belt is formed from continuous strip and wherein the interconnections form V bends.

3. A conveyor according to claim 1 in which the belt is formed from continuous strip and wherein the interconnections form U bends.

4. A conveyor according to claim 1 in which the belt is formed from continuous strip and wherein the interconnections along one side of the belt form V bends and the interconnections along the other side of the belt form U bends.

5. A conveyor according to any one of claims 2, 3 and 4 wherein the struts are formed with projections extending transversely into the spaces between struts the projections of any one strut being staggered with respect to the projections of the adjacent struts.

6. A conveyor according to any one of claims 2, 3 and 4 wherein projection members are attached to the struts and arranged to extend transversely into the spaces between struts, the projections of any one strut being staggered with respect to the projections on the adjacent struts.

7. A conveyor according to any one of the preceding claims wherein the struts are formed to provide stiffening ribs extending along the struts.

8. A conveyor according to claim 1 in which the belt comprises discrete transverse struts mechanically joined at their ends.

9. A conveyor according to claim 8 wherein the ends of the struts are joined together by U shaped clips enclosing the joined ends of the struts.

10. A conveyor according to claim 8 wherein one end of each cross strut is formed of U shape and the other end of each strut is received within the U shape end of an adjoining strut and welded thereto.

11. A conveyor according to claim 8 wherein the end regions of adjacent cross struts are spot welded together in face-to-face contact, a projection on one end region of each strut being formed of U shape.

12. A conveyor according to claim 8 wherein the ends of the cross struts are of rolled tubular form, one end of each strut being formed to a smaller diameter than the other end, the smaller diameter end of each cross strut fitting inside the larger diameter end of the adjacent cross strut.

13. A conveyor according to claim 1, the guide means comprising slideways of channel section, the interconnected ends of the struts running between upper and lower side flanges of the slideways.

14. A conveyor according to claim 13 wherein the belt negotiates a horizontal bend and there is provided a guide wheel on the inside radius of the bend and the edge of the conveyor belt on the inside radius runs in contact with the guide wheel.

15. A conveyor according to claim 13 wherein the belt negotiates a horizontal bend and there is provided a support belt running on rollers in contact with the edge of the conveyor belting on the inside radius of the bend.

16. A conveyor according to any one of claims 13, 14 and 15 wherein the belt is in the form of a closed loop running at each end of its operative upper surface over a horizontal roller and having a lower return section between the horizontal rollers.

17. A conveyor according to claim 16 wherein at least one of the horizontal rollers is mounted at its axis on a swing link so that tension can be applied to the conveyor belt by a spring acting on the swing link.

18. A conveyor according to either of claims 16 and 17 wherein the belt is driven by engagement with at least one horizontal roller.

19. A conveyor according to claim 18 wherein at least one horizontal roller has teeth in engagement with the belt between the struts for driving the belt.

20. A conveyor according to claim 14 wherein the belt is driven by engagement with the guide wheel.

21. A conveyor according to claim 20 wherein the guide wheel has teeth for engaging the strut interconnections for driving the conveyor belt.

22. A conveyor according to claim 15 wherein the support belt is driven by the rollers and the support belt has teeth engaging the conveyor belt between the interconnected ends of the struts.

23. A conveyor according to claim 13 having a conveyor belt according to claim 12 wherein the tubular joined ends of the struts carry headed pins forming upper and lower bearing pads for engaging the upper and lower side flanges of the slideways.

24. A conveyor according to any one of claims 13 to 23 wherein the inextensible element is a cable and the struts have cable slots extending from their lower edges to a point intermediate upper and lower edges, the cable being retained within the slots by bridge prices.

25. A conveyor according to any one of claims 13 to 23 wherein the inextensible element is a cable which runs below the belt, the cable passing through holes in brackets which are attached to the struts.

26. A conveyor according to claim 1 wherein the interconnections carry flanged wheels which run on parallel rails thereby to constrain the conveyor belt to the required path.

27. A conveyor according to claim 12 having free running rollers extending across the width of the belt, the rollers being mounted on shafts extending between brackets fitted in the rolled ends of the cross struts along each

edge of the conveyor belt, the brackets along one edge being inclined in one direction with respect to the longitudinal axis of the belt whilst the brackets along the other edge of the belt are inclined in the opposite direction so that the shafts carrying the rollers extend transversely across the width of the belt between corresponding brackets on either edge of the belt.

28. A conveyor substantially as hereinbefore described with reference to the drawings accompanying the Provisional Specification filed with application no. 12541/71.

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Chartered Patent Agent,
Agent for the Applicants.

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1331194 PROVISIONAL SPECIFICATION

8 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

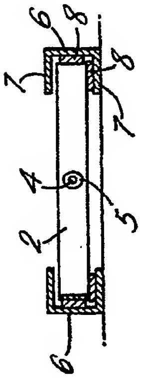


FIG.3.

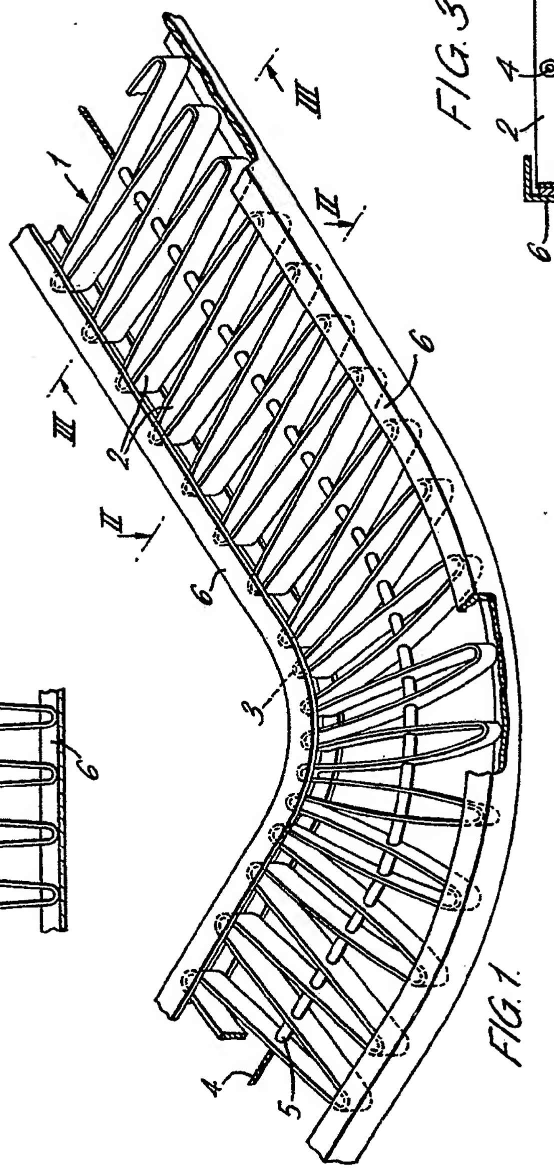


FIG.1.

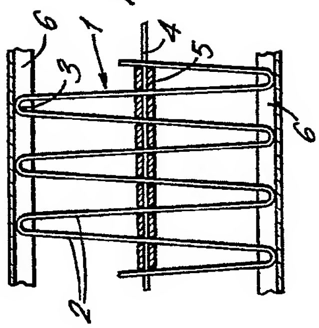
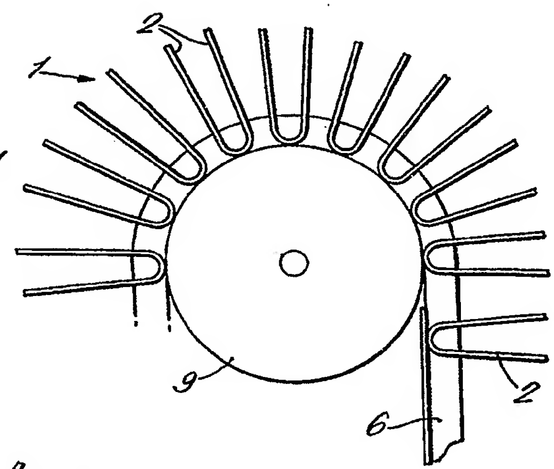


FIG.2.

FIG.4.



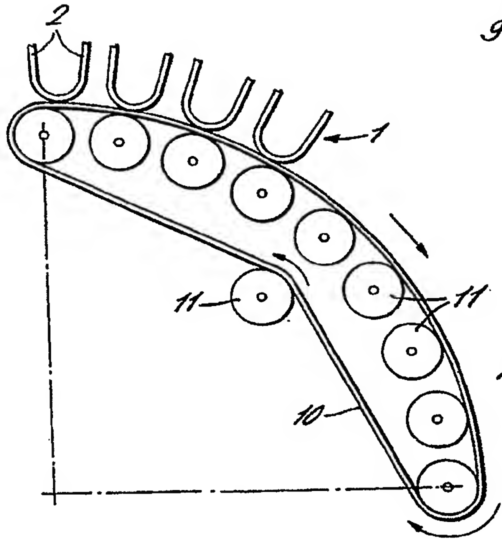


FIG.5.

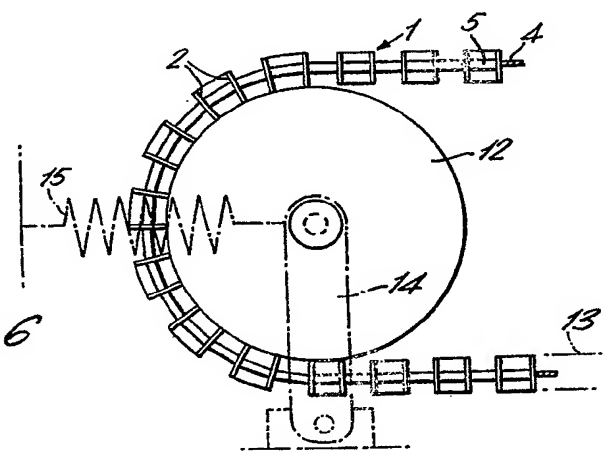
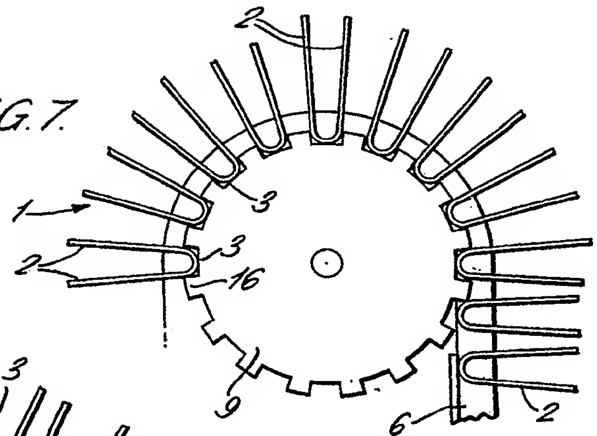


FIG.6

FIG.7.



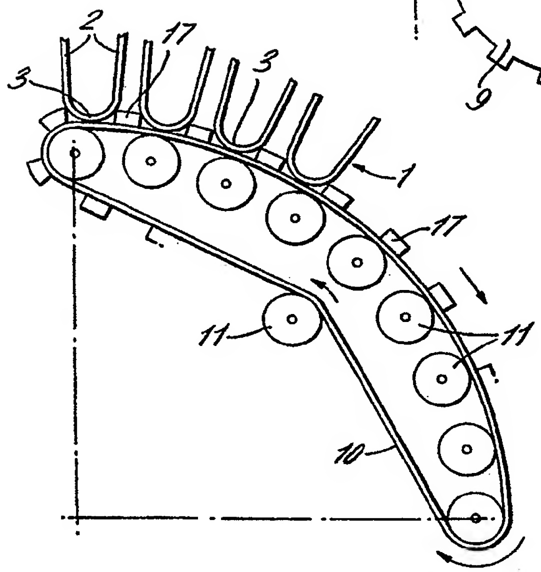


FIG. 8.

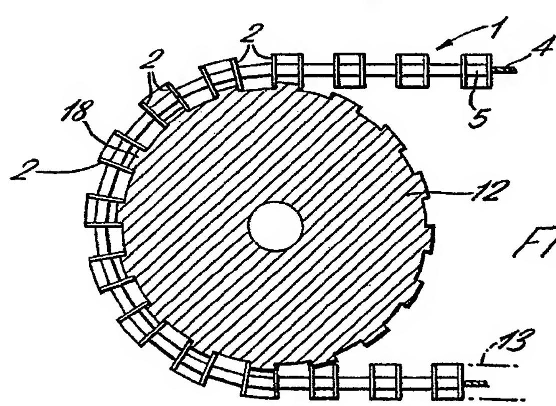


FIG. 9.

FIG. 10.

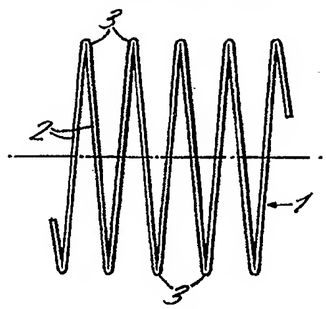


FIG. 11.

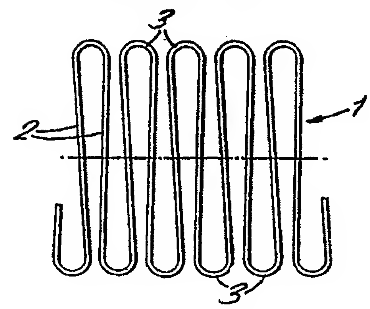


FIG. 12.

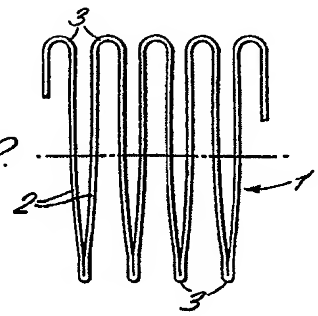


FIG. 13.

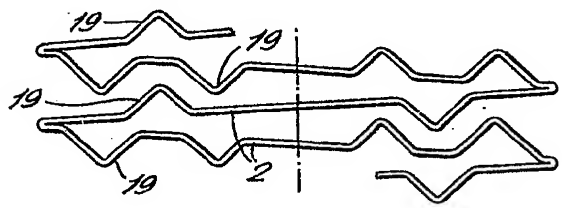


FIG. 14.

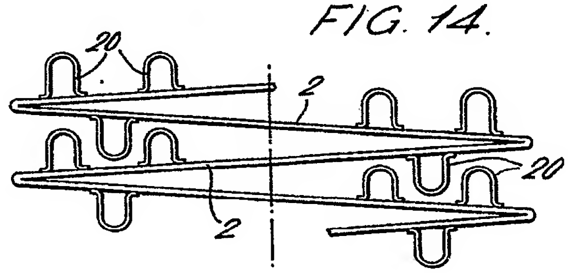


FIG. 15.

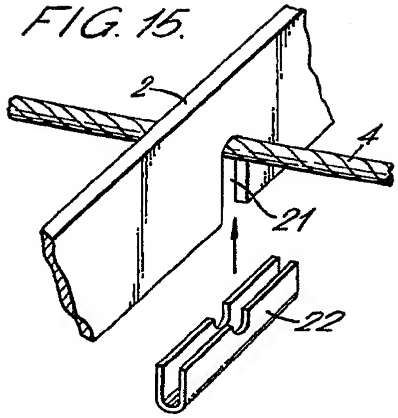


FIG. 16.

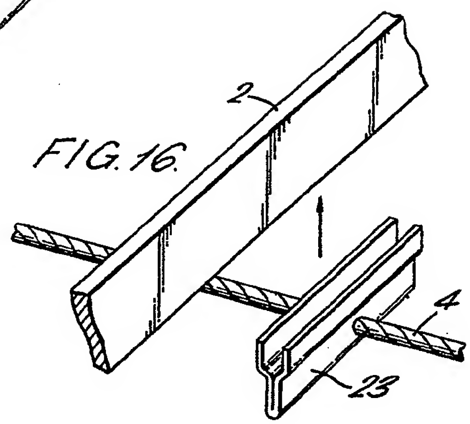


FIG. 17.

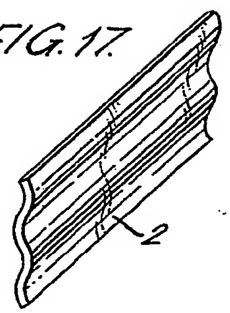


FIG. 18.

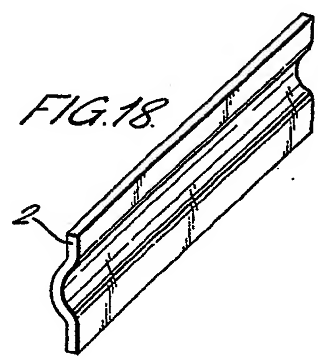


FIG. 19.

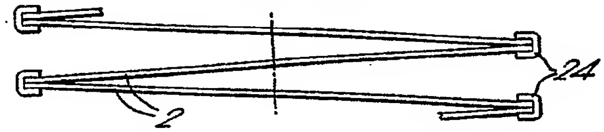


FIG. 20.

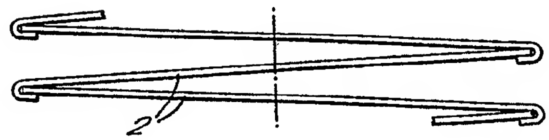


FIG. 21.

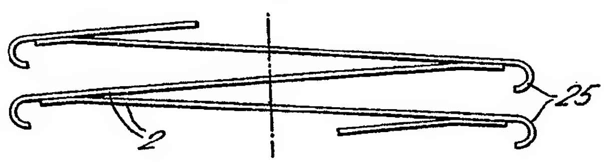
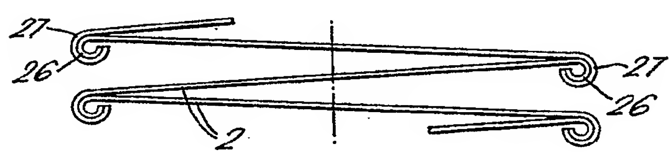


FIG. 22.



1331194 PROVISIONAL SPECIFICATION

8 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 7

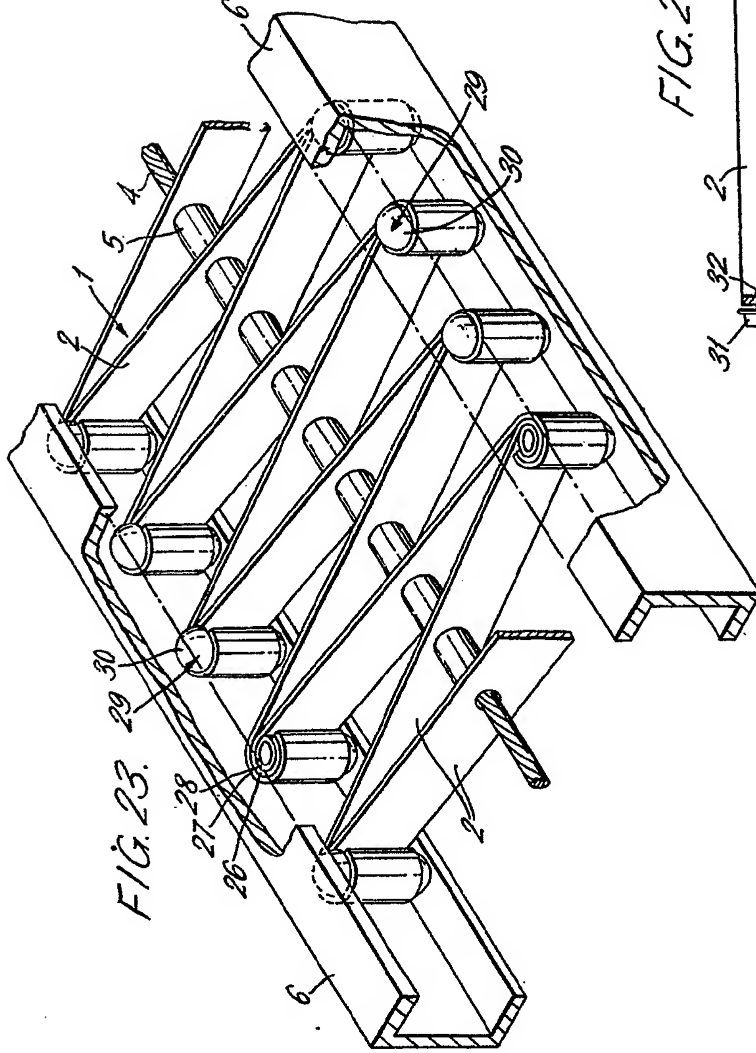


FIG. 23.

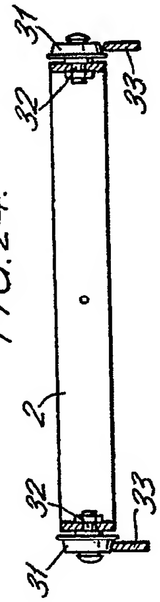


FIG. 24.

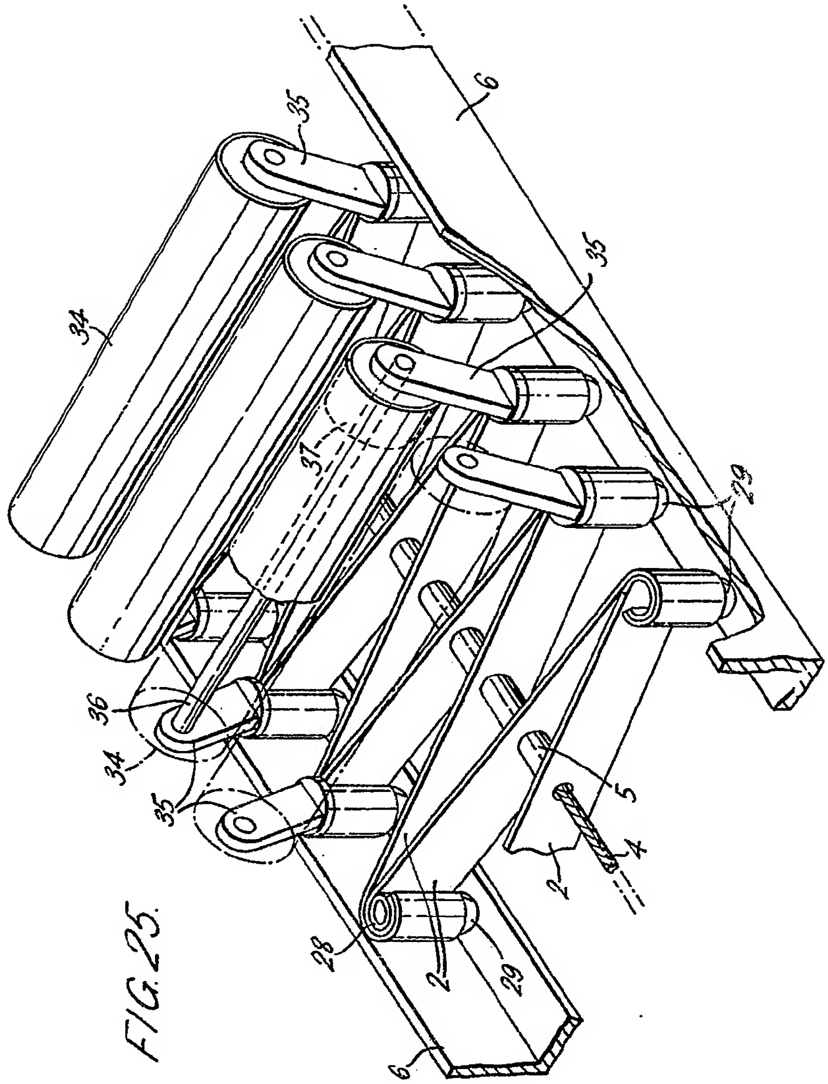


FIG.25.